



(11) **EP 1 130 222 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.09.2001 Bulletin 2001/36

(51) Int Cl.7: **F01M 11/00**

(21) Application number: **01850014.0**

(22) Date of filing: **18.01.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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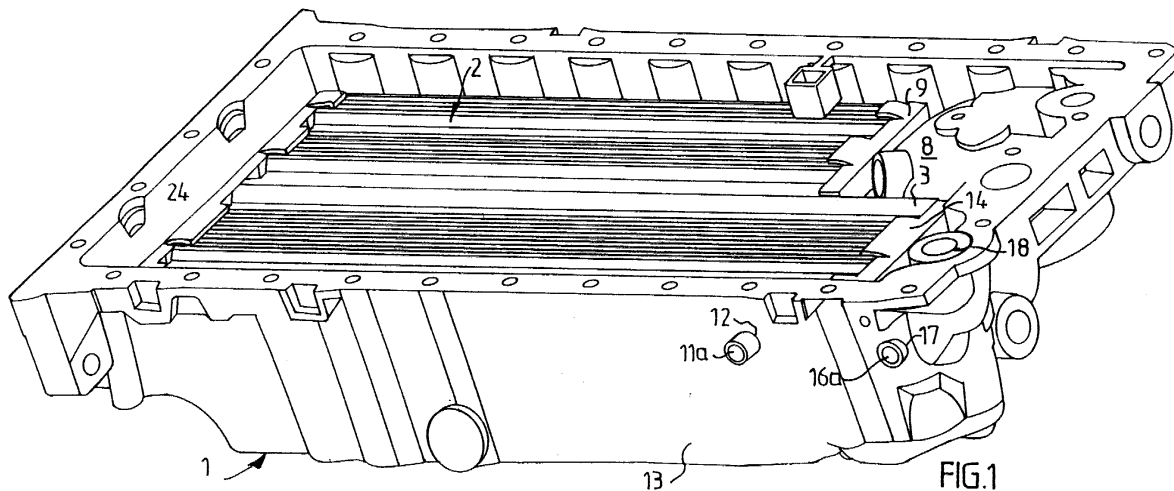
(30) Priority: **20.01.2000 SE 0000165**

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(54) **Oil cooler for internal combustion engines**

(57) Oil cooler for cooling lubricant oil in an internal combustion engine, comprising a cooling element (3), which is arranged in the sump (2) of the engine and has an essentially rectangular plate with longitudinal coolant

channels (4) over the major portion of its extent. The channels are joined with coolant inlet and outlet tubes (11,16), which have connections (11a, 16a) on the outside of the sump for connection to an engine coolant system.



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Description

[0001] The present invention relates to an oil cooler for cooling lubricant oil in an internal combustion engine, comprising a cooling element having at least one channel with an inlet and outlet for a flowing coolant medium and being disposed in a space containing lubricating oil.

[0002] Oil coolers for cooling lubricating oil are available in two main types. One type has the same basic design as a conventional cooler for engine coolant, i.e. it is made up of a large number of thin strips of sheet metal joined together to form channels for oil and flow-through holes for an air flow, e.g. from a coolant fan, which can be the same fan as is used for cooling the coolant in the coolant radiator. The other type has a container through which oil flows in the engine. The container contains a battery of tubes through which coolant flows, which thereby cools the surrounding oil when it flows through the container.

[0003] Common to these two types is that they are arranged outside the engine block itself and that they are connected to the lubricant circuit via outer conduits. This means, firstly, that the engine oil pump must be dimensioned not only for the oil volume in the engine oil ducts but also for an oil volume outside the engine and, secondly, that the oil coolers and the conduits thereto must be dimensioned for the maximum oil pressure of the oil system. The advantage of the latter type compared to the former type is that the coolant is heated more rapidly than the oil, and that for cold starts the oil cooler first functions as a heating element for heating the oil before it needs to be cooled.

[0004] The purpose of the present invention is to achieve a simple, effective and inexpensive oil cooler of the type described by way of introduction, which requires a minimum of conduit installation, and these conduits do not need to be dimensioned for the overpressure of the oil circulating in the engine. This means that the oil pump only needs to be dimensioned for pumping oil to the engine itself and not to an oil cooler outside the engine.

[0005] This is achieved according to the invention by virtue of the fact that the cooling element is arranged in an engine sump and that the inlet and the outlet have connections on the outside of the sump for connection to an engine cooling system.

[0006] In a preferred embodiment of the oil cooler according to the invention, the cooling element comprises an essentially rectangular, extruded and flat aluminum profile with coolant channels over at least the major portion of its extent, and end pieces which are fixed to the short sides of the aluminum profile and have channels, which connect said coolant channels with each other and with said inlet and outlet. The aluminum profile is also made with an oil channel open at both ends, one end of which being disposed to be connected to an inlet tube which projects down into the oil sump, and the other end of which is disposed to be connected to a suction

conduit of an oil pump.

[0007] An oil cooler of this type can be manufactured at lower cost than the previously known oil coolers described above. It has low weight and requires no installation of oil conduits outside the engine itself. When changing oil, all the oil is changed, in contrast to oil changing in an engine with one of the known oil coolers, where a certain amount of old oil will unavoidably remain in the oil coolers. An additional advantage of arranging an oil cooler in the sump is that it is completely protected from corrosion, something which is definitely not the case for, for example, an air-cooled cooler element placed next to the coolant cooler of the vehicle. At the same time there is retained an important property of the previously known oil coolers, viz. that the oil cooler according to the invention also functions as a heating element for heating the engine oil when cold-started.

[0008] The invention will now be described in more detail with reference to examples shown in the accompanying drawings, where Fig. 1 shows a perspective view of a sump in an internal combustion engine with one embodiment of an oil cooler according to the invention, Fig. 2 shows a perspective view of an embodiment of one embodiment of a cooler element in an oil cooler according to Fig. 1, Fig. 3 shows a perspective view of one embodiment of an end piece for the cooler element in Fig. 2, Fig. 4 shows a perspective view of one embodiment of a second end piece for the cooler element in Fig. 2, and Fig. 5 shows a perspective view of the components in Figs. 2-4 assembled to form a unit.

[0009] In Fig. 1, 1 designates a sump, which is intended to be screwed securely to the underside of the crankcase of a cylinder block (not shown) of an internal combustion engine. In the sump 1, an oil cooler, generally designated 2, according to the invention is fixed in a manner not described in more detail here.

[0010] The oil cooler 2 comprises a cooler element 3 (see Fig. 2), which in the example shown is an essentially rectangular extruded aluminum profile, which is made with ten parallel, longitudinal channels 4, which extend over the entire length of the profile 3 and over most of its breadth. The channels 4 have corrugated external walls 5 and corrugated internal walls 6. Furthermore, a longitudinal rib 7 extends through each channel 4 along its entire length. In this manner, a large heat transfer surface and an effective heat transfer between the coolant flowing through the channels 4 and the oil on the outside of the cooling element.

[0011] In the example shown in Figs. 1 and 5, the oil cooler 2 is made to fit in a sump 1, which at one short side has a housing 8. The cooling element 3 is thus made with shorter channels in the area in front of the housing 8. An end piece 9, which is shown in more detail in Fig. 4, is fixed to the ends, facing the housing 8 of the shorter channels 4. The end piece 9 is a unit cast in one piece, preferably of aluminum, and having pipe stubs 10, which project into the channel ends and join them to a channel (not shown), which runs inside the end piece

and which runs into an outlet or inlet tube 11 for coolant. The tube 11 extends through a sealed opening 12 in the side wall 13 of the sump. The outer tube end 11a of the tube 11 is intended to be connected to a coolant hose to or from the vehicle radiator, depending on whether the tube is an outlet or inlet tube.

[0012] The longer channels 4 of the cooling element 3 to one side of the housing 8 are connected, on their corresponding short side, to an end piece 14 which, like the end piece 9, is a unit cast in one piece, preferably in aluminum, which has pipe stubs 15, which extend into the channel ends and join them to a channel (not shown) inside the end piece, said channel in turn opening into an inlet or outlet tube 16 for coolant. The tube 16 extends through a sealed opening 17 in the side wall 13 of the sump. The external end 16a of the tube 16 is intended to be connected to a coolant hose from or to the vehicle radiator, depending on whether the tube is an inlet or outlet tube. The end piece 14 is also made with an oil tube 18 having an end 19 intended to be connected to an oil pump inlet (not shown) and an end 20, which projects into an oil channel 21 made in one piece with the cooling element 3.

[0013] Approximately midway between its ends, the oil channel 21 has an inlet opening (not shown), to which an oil suction tube 22 with an oil strainer 23 is connected.

[0014] At the opposite end of the cooling element, there is an end piece 24 with corresponding tube stubs, which has an interior channel joining the ends of the channels 4 with each other. The end piece 24 is also provided with a plug 25, which seals the end of the oil channel 21. During operation, oil is drawn through the suction tube 22, the channel 21 and the oil tube 18 of the end piece 14 to the engine oil pump. At the same time, the coolant pump of the engine pumps coolant through the channels 4 of the cooling element 3 via the inlet and outlet tubes 11 and 16, respectively.

[0015] The cooling element 3 is fixed in such a manner above the oil level in the sump that the entire cooling element at normal oil level lies above the surface of the oil, and the crank throws of the engine crankshaft sweep immediately above the upper surface of the cooling element, so that oil thrown out by the crank throw strikes the cooling element. In order to make sure that oil will run off the upper surface of the cooling element in a non-inclined engine, the cooling element can be fixed inclined somewhat relative to the upper plane of the sump 1, in principle the horizontal plane. The cooling element can slope somewhat in the longitudinal direction, in the transverse direction or in both of these directions. If the engine itself is placed inclined in the engine room, the cooling element is preferably fixed perpendicular to the cylinder axis.

[0016] The placement of the cooling element in the manner described above also means that the cooling element functions as a splash shield. Instead of a cast cooling element with parallel channels, other types of heat exchangers can be used, e.g. plate heat exchangers.

ers.

Claims

1. Oil cooler for cooling lubricant oil in an internal combustion engine, comprising a cooling element (3) having at least one channel (4) with an inlet and outlet for a flowing coolant medium and being disposed in a space containing lubricating oil, **characterized in** that the cooling element (3) is arranged in an engine sump (2) and that the inlet (11 or 16) and the outlet (16 or 11) have connections (11a, 16a) on the outside of the sump for connection to an engine cooling system.
2. Oil cooler according to claim 1, **characterized in** that the cooling element (3) is flat and has a plurality of longitudinal channels (4), which communicate with each other and with said inlet and outlet (11 and 16, respectively).
3. Oil cooler according to claim 2, **characterized in** that the cooling element (3) is elongated and has a plurality of parallel channels (4) extending in the longitudinal direction of the cooling element.
4. Oil cooler according to claim 2 or 3, **characterized in** that the cooling element (3) is fixed at a distance from the bottom of the sump (2) and covers at least the major portion of the projected surface of the sump.
5. Oil cooler according to one of claims 2-4, **characterized in** that the cooling element (3) comprises an essentially rectangular, extruded and flat aluminum profile with coolant channels (4) over at least the major portion of its extent, and end pieces (9, 14, 24), which are fixed to the short sides of the aluminum profile and have channels, which connect said coolant channels with each other and with said inlet and outlet.
6. Oil cooler according to claim 5, **characterized in** that the extruded aluminum profile (3) is made with an oil channel (21) open at both ends, one end of which being disposed to be joined to a suction tube (22), which extends down into the sump (2), and the other end of which being arranged to be connected to a suction conduit (18) to an oil pump.
7. Oil cooler according to claim 6, **characterized in** that one end of the aluminum profile has an inlet pipe (11 or 16) and an outlet pipe (16 or 11), which are arranged to be exit through openings in the sump and be connected to the engine coolant system, and a suction tube (18) which is joined to the oil channel (21) and which is arranged to be con-

nected to the suction side of the oil pump.

8. Oil cooler according to claim 7, **characterized in** that one short side of the aluminum profile is joined to two cast end pieces (9,14), one of which being cast in one piece with one of said inlet and outlet tubes (11,16) and the other being cast in one piece with the other of said inlet and outlet tubes and with said suction tubes (18) connected to the oil channel (21).

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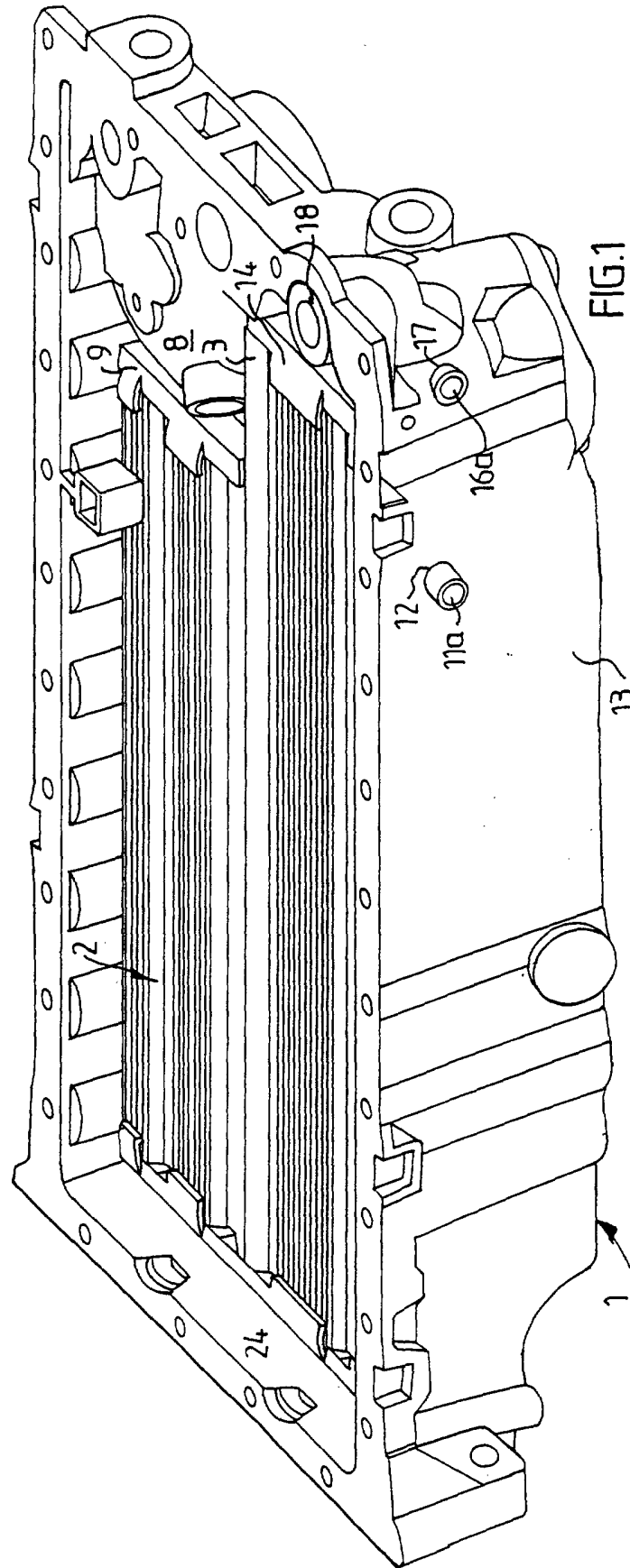
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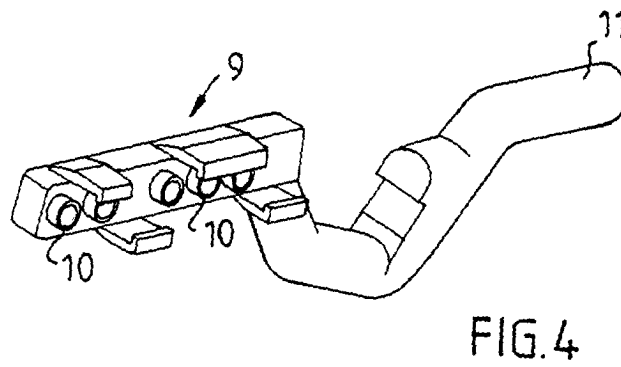
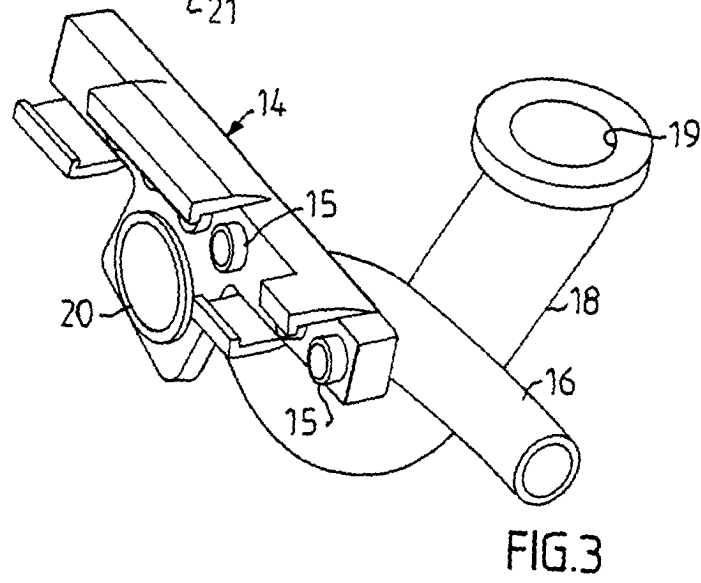
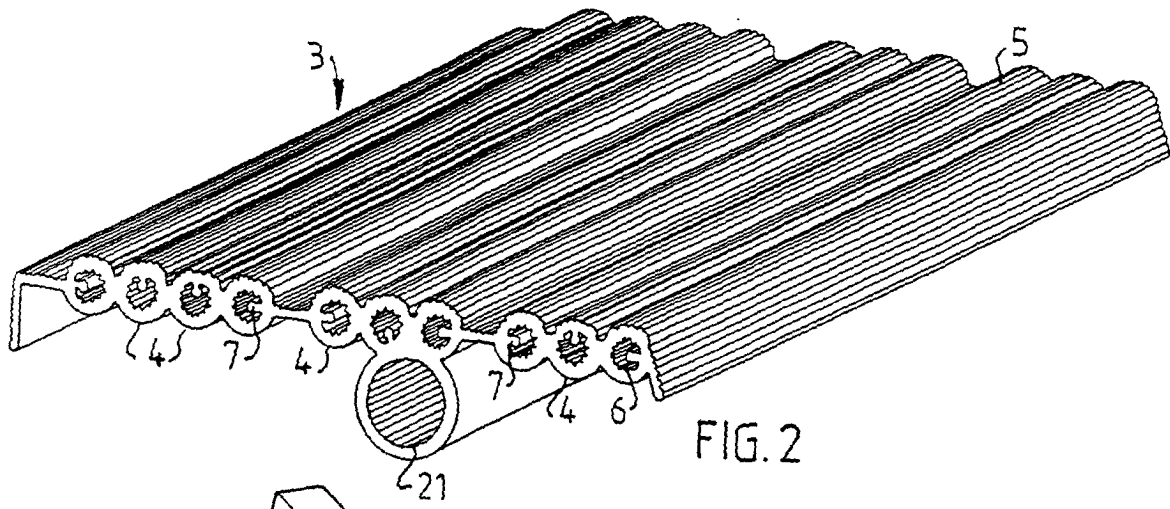
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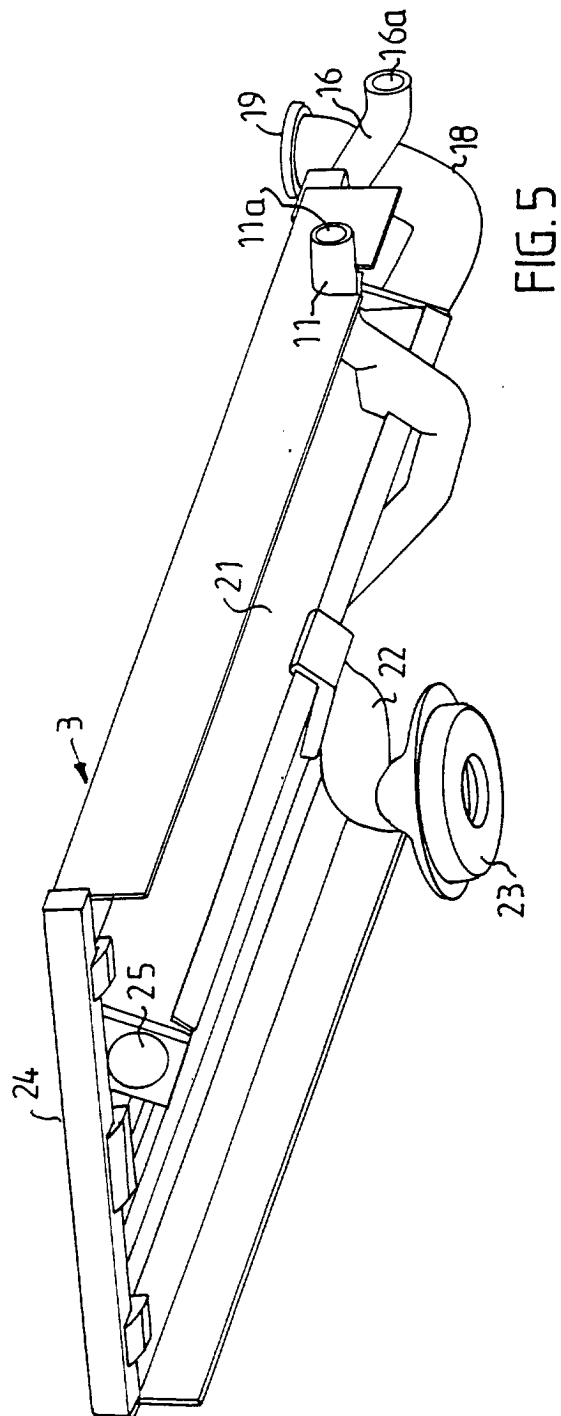
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EUROPEAN SEARCH REPORT

Application Number
EP 01 85 0014

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)		
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The present search report has been drawn up for all claims					
Place of search THE HAGUE		Date of completion of the search 24 April 2001	Examiner Mouton, J		
<table border="0"> <tr> <td> CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document </td> <td> T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document </td> </tr> </table>				CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document	T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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